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SOCIAL DOMINANCE IN RANGE COWS AND ITS EFFECT ON SUPPLEMENTAL FEEDING

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This bulletin reports

one aspect of our range cattle investigations at the San Joaquin Experimental Range, Madera County, which is maintained by the Forest Service, USDA. The studies reported here concern variation in social dominance among different age classes of cows. Such dominance may cause management problems when a mixed-age herd is supplemented on the range.

The main findings are summarized here and discussed in greater detail in the body of this bulletin.

Studied were range cows, aged 2 through 10 years. Hand-feeding supplements to the cows resulted in many 2- and 3-year-olds being driven from the troughs before they had an opportunity to eat their share of the feed. As a consequence, and because of their lower dominance, these age groups suffered greater weight losses than animals of the same age that were pastured and supplemented separately from the older cows.

When a special effort was made to get as many cows as possible to the feeding areas to get their supplements, the average seasonal response was 94.8 per cent, varying from 90.9 per cent for 3-year-olds to 97.5 per cent for 10-year-olds. When the cows were called only (not started or driven), the response was 83.9 per cent, varying from 73.5 per cent for 4-year-olds to 92.9 per cent for 9-year-olds.

At the start of the supplemental period, 8.5 per cent of the cows (of all ages) refused to eat supplements after coming to the feeding area. This class of cows rapidly became insignificant as the season progressed. Some dominant cows coming to the feeding area and not eating caused considerable confusion about the feed troughs because they tried to keep other cows from eating. As soon as the new forage crop came up, an increasing number of cows failed to respond to the call for supplements, amounting to about 8.5 per cent at the end of the period. Annual variation in average seasonal response to call varied from 78.3 to 88.4 per cent over a 5-year period.

Calving was responsible for some decrease in response to call for supplements: 60.4 per cent remained away on the day of parturition; and the 2-, 3-, and 4-year-olds missed about 15 per cent more days after calving than did the older cows.

A study of variation in social dominance in a small herd of mixed-age cows revealed that while a simple straight-line butt order did not exist, each year some cows definitely ranked at the top and bottom. Culling, replacements, and growth resulted in marked changes in the butt order in the herd each year. Age, weight, aggressiveness, agility, and timidity were important factors influencing each cow's social rank in the herd.

Variation in rank was a factor in the utilization of a self-feeder, containing cottonseed meal mixed with salt to regulate daily consumption, by a herd of range cows varying in age from 4 through 10 years during the dry-forage season.

Studies of the use of salt mixed with concentrates, to regulate daily consumption, showed an increasing tolerance (consumption) for salt from weaners to mixed-age cows. It is not known if a similar situation exists from first-calving heifers through aged cows.

Cows moved to the water-feeder area during most of the daylight hours, but not at night. Rate of movement was similar to that previously observed, on this woodland-grass range in late summer, of cows going to water. About 36 per cent came in by 9:00 a.m., another 31 per cent by 2:00 p.m. and the remaining 33 per cent in late afternoon.

Daily attendance at the feeder was high, averaging 98.2 per cent; those missing were of mid-social rank or higher. Cows coming to the area in the morning or during midday usually visited the feeder more than once. When not at the feeder, or water, these cows usually bedded in the vicinity. Some engaged in limited grazing nearby.

The feeder, on the average, was used 12.6 hours a day—about evenly divided before and after midday. Heaviest use, and greatest competition for feeder space, occurred after noon because 57.8 per cent of the cows initially came to the feeder after midday while most of the others, that first had come in during the forenoon, came back to the feeder in the afternoon. For 36.2 per cent of the average day no cows were at the feeder, and for 14.6 per cent only one cow was present. For the remainder of the day from two to 16 cows were at the feeder, and it was during this period that variation in dominance was a factor.

Although the feeder could accommodate eight cows, that many never ate at one time. When the feeder was in use, one cow used it 31.5 per cent, two cows 32.9 per cent, three cows 19.0 per cent, four cows 9.8 per cent, and five or six cows 0.5 per cent of the time. The remaining 6.3 per cent of the time the feeder was unused because of fighting, because dominant cows kept subordinates away, or because of idling.

The combined subordinate 4- and 5-year-old cows spent daily an average of 17.1 minutes eating, 31.0 minutes waiting for an opportunity to eat, and 2.8 minutes idling, as compared with 22.3, 11.5, and 5.4 minutes, respectively, for the dominant older cows. Rates of feed consumption per minute were unknown. The average weight gain, for the dry-forage period, was 36.8 pounds for the combined 4- and 5-year-olds as compared with 60.1 pounds for the older cows.

The importance of the water source was shown by its daily use: 4 per cent of the cows drank four times, 18 per cent three times, 57 per cent twice and 21 per cent once. About 74 per cent of the cows drank before coming to the feeder and about 73 per cent of these watered again before leaving the area.

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CONTENTS

General Management Practices 6
Response to Call for Supplemental Feeding 8
Weaner-yearlings 10
Two-year-old heifers 10
Mixed-age cows 11
Refusal to eat supplements 12
Effects of new forage growth 12
Annual variations 13
Effects of calving 13
Variations in Social Dominance in a Mixed-Age Herd . . . 14
Factors affecting dominance 15
Age 15
Weight 15
Aggressiveness 19
Agility 19
Timidity 19
Response for supplements 20
Space allotments at feed troughs 20
Utilization of Self-feeder 21
Salt as a regulator of supplement intake 22
Variations in social dominance 23
Movement to feeder 23
Daily use of feeder 25
Feeder utilization by age group 29
Watering 31
Literature Cited 32

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Social Dominance in Range Cows and its Effect on Supplemental Feeding[1]

In the initial years of our range cattle investigations (Hutchison and Kotok, 1942; Wagnon *et al.*, 1959), it became evident that management of the breeding groups would have to consider the influence of variations in social dominance. It was our intention to breed the largest possible number of females by one bull, and our original procedure was to place the 2-year-old replacement heifers into their respective breeding herds at the start of the supplemental period during which time they first received the services of a bull. Thus, each breeding herd contained females varying in age from 2 through 10 years. In the supplemented herd, it was noted that the 2-year-old heifers were being driven away from the feed troughs by the older animals and, as a consequence, were not getting their share of the supplement.

This behavioral trait had its effects on animal weights: After the first 4 years (1937 through 1940) in the supplemented herd, the cows 4 years of age and older showed an average weight loss of 154 pounds for the supplemental period as compared with a 25-pound loss for the 2-year-old heifers. Since most of the older cows calved during the supplemental period, a loss in weight was expected; however, the 2-year-olds were being bred for the first time and some gain in weight had been anticipated. During the next 4-year period (1941 through 1944) the 2-year-old heifers were pastured separately but supplemented the same as the older cows. The older cows showed an average weight loss of 116 pounds, while the 2-year-old heifers had an average gain of 46 pounds. Thus, the heifers benefited from the separation.

After the 2-year-old heifers had been removed from the breeding herd, it was noted that many of the 3-year-old heifers, calving for the first time, were now being chased away from the feed troughs. This probably had occurred to some extent when the 2-year-olds had been present but had not been noted. No 3-year-olds had been in the herd in 1937, but they were present from 1938 through 1940. During this 3-year period they had an average weight loss of 130 pounds. In the next 3-year period (1941 through 1943), when the 3-year-olds were observed being chased away from the feed troughs, these heifers had an average weight loss of 216 pounds; this was a loss 99 pounds greater than that of the older cows.

In the eighth year (1944) the 3-year-olds were pastured and supplemented with the 2-year-olds. The cows 4 years old and older showed an average weight loss of 113 pounds, the 3-year-old heifers a 47-pound loss, and the 2-year-old heifers a 43-pound gain. Thus, the 3-year-olds also fared better when they were separated from the older cows during the supplemental period.

The 3-year-olds may have been expected to be dominant over the 2-year-olds, but it was not noticed that they were crowding the 2-year-olds away from the feed troughs. The expression of dominance at these younger ages, although present, is not so marked as in older cattle, and there is less fighting each other away from the feed troughs. From these data it is evident that when a mixed-age group of cows is fed concentrate supplement in troughs, their weight gains will vary even though care is taken to see that all cows are brought to the troughs. The reason for this is that social dominance results in variation in supplement consumption. It was therefore decided to study some of the behavioral traits associated with supplemental feeding on the range.

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GENERAL MANAGEMENT PRACTICES

The cattle used in these studies were predominantly grade Herefords. They resulted, unless stated otherwise, from breedings by purebred Hereford bulls from the University's purebred herd. During the weaning process calves were taught to eat concentrates they would receive later as supplements. Even so, a few animals on the range would refuse to eat the supplements, either for a period or altogether. These latter were usually removed from the experimental groups. All animals were dehorned prior to weaning.

Cattle groups being hand-fed supplement were called by voice to a designated area of their pasture. In the smaller pastures, 200 acres or less, the feeding site was usually selected for its convenience to an existing road. In larger pastures, and some smaller ones, topography and distances to various parts of the pasture had to be considered. This was done because in hilly country cattle would be in ravines or behind a hill where it would be difficult for them to hear the feeder calling, especially if windy. Thus, in some pastures it was necessary to establish a feeding site on a ridge or hilltop.

Concentrate supplements were fed in aligned (for the most part) 3×12-foot wood troughs that gave a minimum linear space of about 1.5 feet per weaner calf to about 2 feet per mature cow. Since each group was fed in common troughs, it was up to each animal to get its share of trough space and supplement. The supplements were mostly cottonseed cake or pellets and rolled barley. Linseed pellets and ground milo were used to a limited extent. The protein supplement was fed in cake or pellet form to prevent the animals from eating it too rapidly. If the cake or pellets were too soft, the older and dominant animals were able to eat them too rapidly; if they were too hard, the younger animals would tend to spit them out or refuse them. Some cake and pellets were so hard they resulted in a few broken teeth. Hard supplements were exchanged for less hard ones. Weaner calves were fed pea-sized cake or ⅜-inch pellets, older animals nut-sized cake or ¾-inch pellets. In later years when the concentrates were self-fed, with hay salt as a regulator, the protein supplement was cottonseed meal. When baled hay was the supplement to augment a diminishing forage supply, it was scattered on the ground.

Starting about July 1, the daily ration was 1 pound of protein supplement per head until October 1, when it was increased until the calves were receiving 1½ pounds and the cows 2 pounds per head. When winter rains commenced, usually in October, rolled barley was added to bring the daily ration up to 3 pounds per head. In 1938, some groups were fed only on alternate days (Wagnon *et al.*, 1959).

The feeder began his round about 8 a.m., usually starting in the pastures near headquarters. Sometimes he called as he moved along, but mostly he called from the feeding site, or adjacent hilltop, in each pasture. Thus, cattle in the more distant pastures usually heard the calling before the feeder reached the feeding site in their pasture. Before 1946, the feeder traveled mostly by horseback (each feeding site also had a feed storage box) and afterwards mostly by pickup truck. He made an effort to get as many animals of each group as possible to the feeding site. At times, in the larger pastures, he would spend an hour or more calling cattle (fig. 1). Laggard animals, frequently located by their bawling in response to the feeder's calling, were started to the feeding area and in some cases driven there. From 1953 through 1957 none of the laggard cows in pasture 13 were started or driven to the feeding site. Cows responded to calling only.

Each animal had an identifying numnumber, the first figure indicating year of birth, branded on its right hip. Thus, unless hair was allowed to obscure the brands, it was easy to identify each animal. The feeder kept a daily record of his operations and, for the most part, recorded the numbers of missing animals.

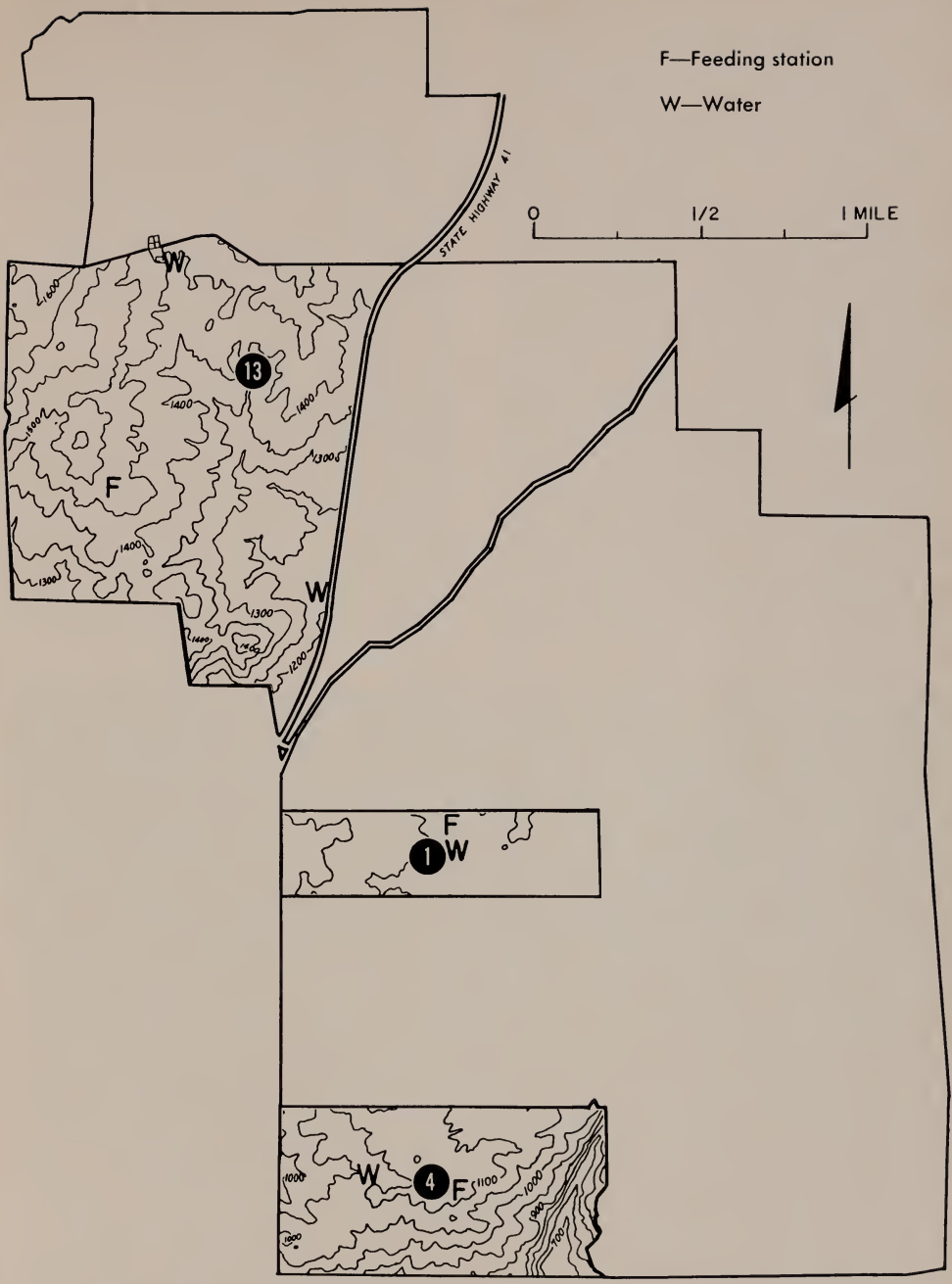

Fig. 1 San Joaquin Experimental Range showing pasture arrangement on pastures 1, 4, and 13 during the latter years of this study.

This was especially true in the mixed-age breeding groups. In the single-age groups, such as weaners and yearlings, he tended to record just the total number of animals not responding to call. In 1955–56 through 1957–58 cows in pasture 13 responding to call and then refusing to eat supplements were recorded.

To secure more detailed information on dominance in a mixed-age breeding group, records were made over a 5-year period of the results of butt contests (either both fighting or one butting another away) in a small breeding herd (F) of 10 to 12 cows grazed year around in pasture 4. This was done by randomly recording butt contests observed at the feeding site during the supplemental period while the cows were standing about waiting to be fed. No contests were recorded after the animals were given their feed. Retreats from threats, while the cows were waiting about the feeding area, were not recorded for fear of misleading results. For the same reason, butt contests were not recorded after the feed was placed in the troughs. The total amount of supplements fed per cow is small and if she fights while there is feed in the trough other cows will eat her share. Thus, cows tend to avoid conflicts and to move to an uncontested spot at the troughs where feed is available. Subordinate cows have been observed to butt a dominant cow away from a position at the trough.

The first year the animals were fed in one 3×12-foot fed trough; during the second year a second trough was added. At first, these troughs were placed parallel about 15 feet apart and later in alignment about 8 feet apart. Culling and replacement took place each year about July 1, at the start of the supplemental period. Cows passing 10 years in age were culled for age; others were also culled for health reasons and barrenness. Replacements were usually 3-year-old heifers, but several older animals were also used. Recording of butt contests commenced shortly after the culling and replacement had been completed.

The use of salt, mixed with concentrates to regulate daily consumption of supplements on the range, was widely adopted as a self-feeder practice by stockmen during the latter years of this study. To secure information on the use of such a self-feeder, data were collected over 3-day periods in August, 1955, and September, 1956. The herd consisted of 47 cows (in pasture 1 plus 2) varying in age from 4 to 10 years, and was fed with an 8-foot feeder that was about 280 feet from water (fig. 1). A record was made of each animal that came to the feeder, the amount of time used in consuming feed, fighting about the feeder, and watering behavior before and after coming to the feeder. Data were collected from daylight to dark. The ground about the feeder and the water was raked before leaving so that it could be determined if animals visited the feeder during the night.

RESPONSE TO CALL FOR SUPPLEMENTAL FEEDING

Hand-feeding supplements to range cattle poses two problems. The first is to get all the animals to come at call to the feeding area, and second is to see that each gets its share of supplements. When the fields are small, fairly open, and smooth, it is generally easy to get response to call. When the pastures are large, brushy and rough, difficulties may arise. In our study, we made sure that cattle in possible blind spots, such as in ravines and behind hills, heard the call. Also, time was allowed for distant animals to get to the feeding area.

As mentioned before, trouble was en-

countered in feeding groups of cows of mixed ages because dominance varied among different age groups. If the cows would not move up to the trough when the feed was put out, and compete with the others, they were likely not to get their share of supplement.

In our supplemental feeding studies (Hutchison and Kotok, 1942; Wagnon *et al.*, 1959), it was our practice to begin feeding 1 pound of cottonseed cake per head daily early in the dry-forage season, when the cattle were starting to suffer weight losses. It was more efficient to promote weight gains at this period with a small amount of supplement than to wait until the winter period when forage resources were poor and the animals had lost considerable weight. This was especially true with cows that calved at the onset of the winter period.

At the time supplemental feeding started the cattle had been moved to new pasturage, except in one study which used year-around grazing in one field, that had not been previously grazed that season. Thus, while the forage was predominantly dry, the pastures contained various amounts of swales and other fertile spots that produced more preferred forage than the rest of the pasture. Consequently, at the start the cattle were busy seeking out this forage, and some showed less interest in the cottonseed cake supplement than they would later. During this early period it was common to encounter individuals that would not eat the cottonseed pellets even though the animals responded to call. Many of these had to be started or driven to the feeding area. While the others ate supplements at the feeding area, one of these individuals might spend her time taking salt, or, if she was one of the dominant ones, might stand near the troughs and attempt to keep others from eating. As a consequence there could be considerable milling about the troughs which would result in the younger animals and other subordinates being driven away before they had an opportunity to get their share of the supplements (fig. 2).

Fig. 2. Three-year-old heifers, just before calving, milling about feed trough. Animals of higher social standing, not interested in eating supplements, attempt to keep others from eating.

One pound of cottonseed pellets per cow is quickly eaten, and there has been some concern as to whether the cows would consider it worth traveling a considerable distance to get it. This was especially true in pasture 13 where the feeding area was distant from water (fig. 1). A feeding area near water is convenient for the cattle, because when walking to the feeding area, they are also going to water. In pasture 13, many cows came directly from their grazing area to the supplemental feeding area and then went back to water as soon as the supplements had been eaten. Others went from the grazing area to water and then to the feeding area. These cows prolonged the time required to feed the group, especially when they had to climb a hill after taking a fill of water. This same situation existed to varying extents in other pastures depending upon the location of the feeding area in relation to pasture water sources.

When the feeder moved to the troughs with the feed, the social dominants of the group usually crowded up to the troughs, unless afraid of the feeder, to get first opportunity at the feed; others crowded in behind him as he spread the feed. When the cows were hungry, they usually ate rather industriously until most of the feed within easy reach had been eaten. Then, if they couldn't force adjacent cows to yield trough space, they would back away and seek an uncontested place. When this movement starts, the subordinates, which may have withstood previous butting about, begin to be chased away. Early in the supplemental period the subordinates seem to yield easily. However, as the supplemental period progresses, and the forage resources become increasingly worse, hunger forces the subordinates to withstand more butting about before yielding (especially young cows that have recently calved). Unfortunately, by this time most of them have lost so much weight they cannot adequately regain their previous fleshing under prevailing conditions.

In the early spring as the new forage becomes increasingly available, the cattle are so attracted to the new growth that they lose interest in the supplements. During some exceptionally open winters, or unusually early development of new forage growth, the cattle tend to quit taking supplement at an earlier date than may be desired.

WEANER-YEARLINGS

For the most part weaner-yearlings were pastured in the smaller pastures (7–10), and attempts were made to get all animals to the feeding area. Dominance within the groups was not studied. Animals of this age tend to "spook" easily, mostly from trespassing dogs and hunters in our case, and on some days such animals were not fed, thus allowing them to calm down.

In a study of a total of six groups of calves (156 head) that were supplemented in the usual manner, we had an average response to call of 95.2 per cent. In four other groups (48 head) that were fed at a heavier rate to promote average daily gains of 1.0 to 1.25 pounds, the calves showed more interest in their supplements, and we had a response to call of 98.9 per cent. This indicates that amount of feed fed per head has some effect on their response to call.

Within this age group no problem existed of a dominant keeping a subordinate away from the feed troughs. There was some expression of dominance but not so marked as in later ages. The calves tended to crowd around the troughs and stay until the supplement was eaten. Animals were more likely to be crowded out than to be chased away as subordinates.

TWO-YEAR-OLD HEIFERS

Like the above younger-age animals, 2-year-old heifers were also pastured in the smaller-sized pastures and attempts were made to get all animals possible in for feeding. Data were available for 4 years and for a total of 48 heifers. Average response to call was high at 97.3 per cent. In one year, however, 13 heifers were pastured in the larger pasture 11, and response for that year was 93.0 per cent.

While the expression of dominance in this age class was more marked than with the weaner-yearlings, it still was not a problem in supplemental feeding.

MIXED-AGE COWS

When efforts were made to get as many of the cows as possible to the feeding area we had an average attendance, over an 11-year period, of 94.8 per cent (fig. 3). Animals in these breeding groups varied in age from 2 to 10 years; however, data from the 2- and 3-year-old age classes are limited because this age group was removed after the first few years. Response, by age class, varied from 90.9 per cent for the 3-year-olds to 97.5 per cent for the 10-year-olds. The 2-year-olds showed a 94.5 per cent response while those 4 years old and older varied from 95.3 to 97.5 per cent.

The lower response of the 3-year-olds was partly the result of a greater reluctance to leave newborn calves than was shown by cows that had experienced previous pregnancies (see table 1). While we urged animals to go to the feed area, cows with newborn calves were not molested. When their calves were considered old enough to travel or be left, we again urged the cows to go to the feed area if they did not do so.

When the cows were called only from the feeding area and along the road to the area, we found a marked decrease in response to call (fig. 3). Seasonal averages within the 4- to 10-year age classes show a decrease from 95.8 to 83.9 per cent, or almost 12 per cent, in response to call. Within each age class the response to call was significantly ($P = < 0.05$) lower in each case than when efforts were made

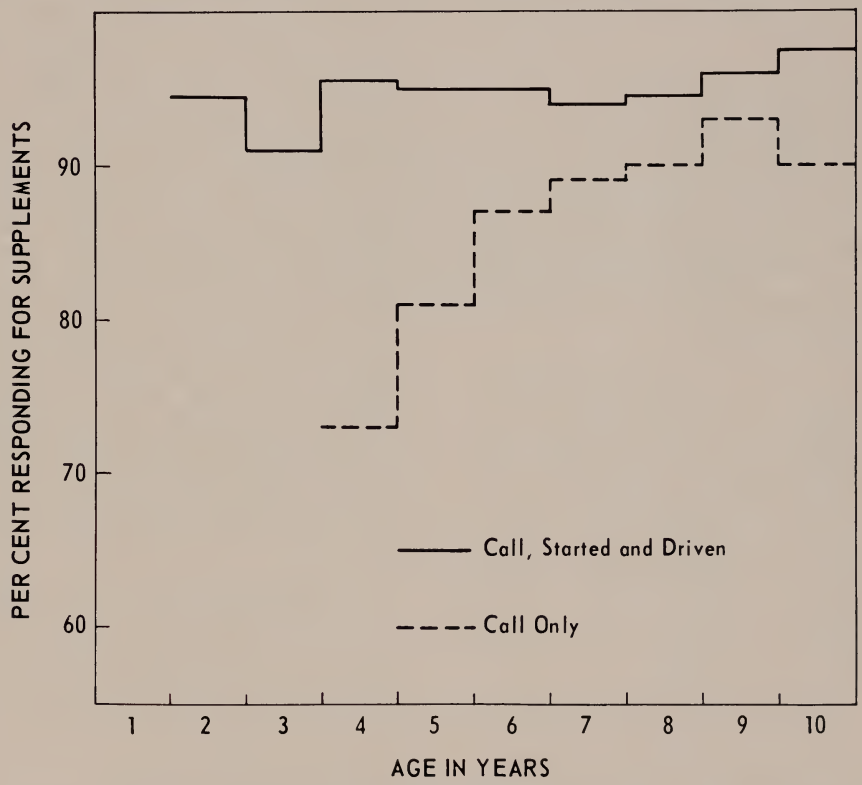

Fig. 3. Effects of social dominance on response to call in mixed-age breeding cows. When efforts were made to get as many cows as possible to the feeding area by calling them, starting them on their way, and drive them (solid line), response was higher in all age groups, as compared with a system whereby cows were called only (dotted line). The difference between age groups was significant in each case. Two-year-olds were present only the first four years of an 11-year study period. During the five-year period when cows were called only, three-year-olds were not added to the herd until after they had calved.

to get all animals possible to the feeding area. Furthermore, the response to call by age classes with calling only, varied significantly ($P = < 0.05$) among successive age groups. The lowest response was shown by the 4-year-olds at 73.5 per cent, followed by a progressive increase for each age group, to a high of 92.9 per cent for the 9-year-olds. The response then dropped to 90.3 per cent for the 10-year-olds. These data show increased response to call by increasing dominance, as related to age group, from 4 to 9 years of age after which response to call began to decline. Thus, variation in social dominance had significant effects on the response of the various age groups to call for supplements. These data also indicate, by age groups, that a peak in dominance was reached at the ninth year of age.

REFUSAL TO EAT SUPPLEMENTS

During the last 3 years of the 5-year period, in which a mixed-age group was called only from the feeding area (1955–1958), the following data were recorded on cows refusing to eat supplements after responding to call:

Age class (years)	Total cow days	Refusing to eat supplements (per cent)
4	3,079	2.2
5	3,656	1.5
6	3,333	3.4
7	2,849	0.9
8	2,914	2.3
9	2,236	3.7
10	2,302	2.6
	20.369	Ave. 2.4

These data show that an average of 2.4 per cent of the cows refused to eat supplements after responding to call, and that all age classes were affected. It is doubtful, however, if the differences among age groups are meaningful.

Refusal to respond to call was broken down by months for the same period:

Month	Total cow days	Refusing to eat supplements (per cent)
July	2,420	8.5
August	3,495	2.2
September	3,467	0.3
October	3,666	1.9
November	3,092	3.2
December	2,927	0.6
January	971	0.3
February	331	0.0
	20,369	Ave. 2.1

These data show that 8.5 per cent refused to eat in July when feeding started, but that the percentage dropped to 2.2 per cent in August and to a negligible 0.3 per cent in September. Cows refusing to eat at the start were those that had eaten well in previous years, and ate well in subsequent years of the study. The reason for this initial refusal is not known but, since the cattle had just been turned into pastures previously ungrazed that season, it is possible that the initial abundance of more preferred forage had decreased the attraction for supplements. As this supply of preferred forage (Wagnon, 1963) was rapidly depleted, and the cattle had to eat more of the less desired forage, refusal to eat supplements decreased rapidly.

The above data also show a 1.9 and 3.2 per cent refusal to eat in October and November, respectively. While not significant, these data are in accordance with observed behavior at initiation of the new forage crop.

The newly germinated plants strongly attract the grazing cattle, causing them to lose interest in the supplements; but subsequent adverse weather hinders new plant growth and stimulates renewed interest in the supplements.

EFFECTS OF NEW FORAGE GROWTH

In the latter weeks of the supplemental season, when the new forage progressively improved, the cattle responding to call continued to eat, but did more milling about the troughs. Also, absenteeism pro-

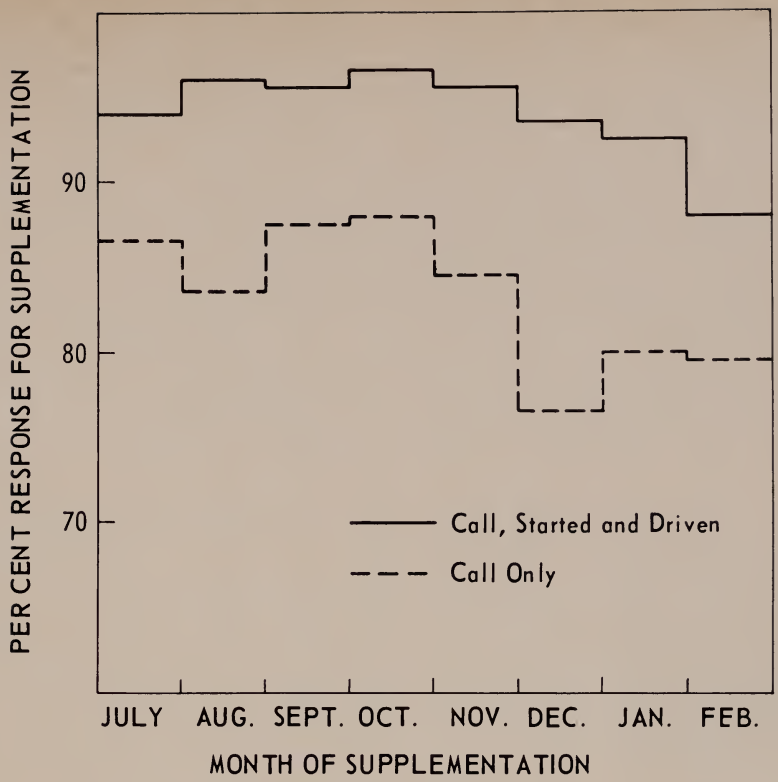

Fig. 4. Effects of new forage development (usually started by November) on response for supplements.

gressively increased, whether efforts were continued to urge the cows to come in or the animals were left to their own resources (fig. 4). As shown below, calving also tended to reduce response for supplements during the latter half of the supplemental period.

ANNUAL VARIATIONS

During our long period of studies of the supplementation of cattle on the range, it was noted that in some years it was apparently more difficult to get the cattle to respond to call for supplements than in others. Data presented below, from 1953–54 through 1957–58, show a significant 10 per cent difference between a 78.3 per cent response in 1953–54 and an 88.4 per cent response in 1956–57. Reasons for these variations are not known, but possibly are caused by annual differences in forage quality and abundance.

Year	Length of supplemental period (days)	Number of cows	Responding to call (per cent)
1953–54	174	53	78.3
1954–55	196	50	86.8
1955–56	164	43	84.6
1956–57	195	48	88.4
1957–58	185	45	80.6

EFFECTS OF CALVING

Response to call for supplements decreases after calving, but this is felt to be an influence of age rather than of social dominance. In this study it was found that before calving the average response to call was 86.7 per cent, and after calving 79.1 per cent. A summation of these data in table 1 shows a low response in the 3- and 4-year-olds, increasing response

by age up to 9 years and then a decrease in response for the 10-year-olds. The data also show that the 3- and 4-year-olds missed more days in the 5-day period before calving and the 5-day period after calving than the older cows. About 40 per cent of the cows came to the feeding area on the day they calved, with the 3- and 9-year-olds missing more calving days than the other ages.

TABLE 1

EFFECTS OF CALVING ON RESPONSE TO CALL FOR SUPPLEMENTS FOR THE VARIOUS AGE CLASSES IN BREEDING GROUP I FROM 1953–54 THROUGH 1957–58

Cows used in test		Days missed		Average of days missed over 5-day period		Missing calving day
Age class	No. cows	Before calving	After calving	Before calving	After calving	
years		*per cent*				*per cent*
3*	14	21.5	30.4	1.1	2.4	78.6
4	41	22.2	32.9	1.6	2.7	58.5
5	30	15.0	23.8	0.8	1.8	60.0
6	28	12.6	14.1	1.1	1.8	57.1
7	26	9.0	16.3	0.8	1.9	53.8
8	24	8.7	13.3	0.6	1.0	54.2
9	17	4.9	9.2	0.1	1.4	70.6
10	17	6.4	14.6	0.8	1.9	64.7
Total or average	197	13.3	20.9	1.0	1.9	60.4

* 3-year-olds present only in 1953–54.

VARIATIONS IN SOCIAL DOMINANCE IN A MIXED-AGE HERD

The herd used in this study was established in 1948 with 12 cows, varying from 4 to 9 years in age, taken from a previous unsupplemented breeding group. Thus, they all had similar origin and previous association with each other. In their new grouping they remained year around in one pasture (4) until they were culled or died. All cows were culled after reaching 10 years.

In 1950 one 3-year-old and one 4-year-old replacement were added. The latter was a small animal with a 6-inch horn stub that she used quite effectively. This horn stub was removed before the start of the data collection in 1952. In 1951 an Angus-Hereford 3-year-old was added, and in 1952 four replacements consisting of a 3-year-old, a 4-year-old, a 7-year-old and an 8-year-old. The 8-year-old came from a group in which she had a long previous residence and established routine. The last year the replacements consisted of three 5-year-old Angus-Hereford cows that were half-sisters of the 1951 Angus-Hereford replacement.

Over the 5-year period, recorded butt contests varied from 529 to 1,212 yearly, totaling 3,637. The dominance rank of each cow within the herd is expressed in table 2 as the percentage of other animals she dominated in the herd that year. These data show that a simple straight-line butt order (where each successive cow dominates all those below in succession but none above) did not prevail in any of the five years. However, each year there was one cow that was definitely dominant over all the others within the herd.

Each year, 2 or 3 cows had the same ranking. In some instances these equal ratings might be broken into successive rankings, but this is not always a simple process. For example, in 1949, Nos. 173, 176 and 332 each dominated 3 cows and had an equal ranking of 33 per cent. No. 176 dominated both 173 and 332, and 173 dominated 332. Thus, these cows might be ranked in the order 176, 173, and 332. However, No. 332 dominated 223 that dominated both 176 and 173. In 1953, Nos. 420, 668 and 758 each dominated 8 cows and had equal ranks of 73 per cent. Here each of these cows dominated one of the others but a low-ranking cow dominated one of the trio.

FACTORS AFFECTING DOMINANCE

Schein and Fohrman (1955) show high correlation coefficients for rank $\times$ age ($r = 0.93$) and rank $\times$ weight ($r = 0.87$) in their study of social dominance relationships in a herd of dairy cattle. They had studied cattle with a much wider range in age and weight than we did. They also used some data based on the assumption that if cow A dominated cow B and cow B dominated cow C then cow A dominated cow C even though no contest between A and C had been recorded.

Other factors affecting dominance are aggressiveness, agility, timidity, and horns. Except for the latter, these factors are difficult to assess or measure. Our animals were dehorned, and horns therefore were not a factor except in the one case mentioned before.

AGE

In only 1 year of the 5 years studied was the dominant position held by one of the oldest cows. At the start in 1949 the dominant cow was 9-year-old No. 026. This cow easily held her rank by having won 103 out of 104 recorded contests. The following year she was displaced by 7-year-old No. 348 that held the dominant position for 3 years, until she was culled. At the time No. 348 first attained group dominance, another 7-year-old cow (No. 347) held the bottom rank of 0. Like her predecessor, No. 348's dominant position over the 3-year period was never seriously contested, as she won 87 out of 88, 207 out of 207, and 78 out of 78 recorded contests, respectively. When No. 348 was culled, 10-year-old No. 332 moved into dominant position. She also held her position easily with 141 wins out of 143 recorded contests. While these data show that age is a significant factor in aiding a cow to attain rank ($r = 0.62$, $P > 0.01$), there is also evidence that old age contributes to a decline in rank. This was previously noted in the discussion of dominance and its effect on response to call for supplements.

WEIGHT

The weights used in this study were taken just before the start of the calving period, in late September, and were the highest attained during the supplemental period. While weight is closely associated with age (growth to full maturity), there are marked differences in the weights of mature cows in this study. In a range breeding herd, marked differences in annual weight changes among individuals are to be expected because of differences in reproduction, lactation, and health as influenced by seasonal differences in range condition and amount of supplements eaten. It should be mentioned again that the cows starting this herd all came from a previously unsupplemented herd. Consequently they had been retarded in normal growth and fleshiness, and most markedly increased in body weight after receiving supplemental aid during the dry-feed and winter seasons. This is well illustrated by the successive weights of the cows that were present in the herd in 1949 (table 2).

In this study the heaviest cow was dominant the 3 years that No. 348 was the dominant cow of the herd. The other 2 years the heaviest cow was a 6-year-old. However, small cows, such as 223 and 235 never attained high ranks in the herd. Weight was found to have a significant influence on the rank attained ($r = 0.58$, $P < 0.01$).

TABLE 2

ANNUAL SUMMATION OF COW DOMINANCE IN BUTT-ORDER RANK, OVER THE YEARS AS AFFECTED BY CULLING, REPLACEMENT, AND AGING,

Cow no. (arr. by descending rank)	Recorded butt contests between individual cows Individual contests (won:lost)											Total contests (won:lost)	Percentage of herd dominated	Response to call (per cent)	Not eating (per cent)	Age (yrs)	Weight (pounds)
1949																	
	026	908	348	235	223	173	176	332	420	347							
026	—	10:1	14:0	7:0	11:0	19:0	14:0	14:0	4:0	10:0		103:1	100	97.6	0	9	1,195
908	1:10	—	15:2	23:0	27:0	31:0	12:0	39:0	13:0	14:0		175:12	89	92.3	0	10	1,160
348	0:14	2:15	—	22:0	29:0	19:0	13:0	32:0	14:0	9:0		140:29	78	91.3	0	6	1,322
235	0:7	0:23	0:22	—	5:0	14:1	6:1	12:1	8:0	2:0		47:55	67	90.4	0.5	7	1,002
223	0:11	0:27	0:29	0:5	—	21:1	25:0	0:14	10:0	4:0		60:87	44	87.5	1.7	7	820
173	0:19	0:31	0:19	1:14	1:21	—	0:24	26:1	12:0	15:0		55:129	33	92.3	0	8	1,127
176	0:14	0:12	0:13	1:6	0:25	24:0	—	18:1	1:17	3:0		47:88	33	88.5	0.5	8	927
332	0:14	0:39	0:32	1:12	14:0	1:26	1:18	—	12:0	4:0		33:141	33	97.1	0.5	6	1,147
420	0:4	0:13	0:14	0:8	0:10	0:12	17:1	0:12	—	21:0		38:74	22	84.6	28.4	5	917
347	0:10	0:14	0:9	0:2	0:4	0:15	0:3	0:4	0:21	—		0:82	0	80.8	26.8	6	940
1950																	
	348	026	235	173	176	332	223	420	668	758	347						
348	—	7:1	3:0	13:0	1:0	20:0	7:0	10:0	11:0	9:0	6:0	87:1	100	91.0	1.4	7	1,401
026	1:7	—	13:0	8:0	8:0	16:0	9:0	2:0	9:0	9:0	7:0	82:7	90	97.4	0	10	1,261
235	0:3	0:13	—	3:0	5:1	5:0	2:0	0:0	5:1	3:0	2:0	25:18	70	96.1	0	8	1,049
173	0:13	0:8	0:3	—	0:16	16:2	1:7	10:0	14:0	6:0	4:0	51:49	50	92.9	0	9	1,348
176	0:1	0:8	1:5	16:0	—	19:0	0:15	1:15	17:1	12:0	9:0	75:45	50	96.1	0.7	9	1,024
332	0:20	0:16	0:5	2:16	0:19	—	18:2	10:1	23:1	9:0	6:0	68:80	50	99.4	0	7	1,202
223	0:7	0:9	0:2	7:1	15:0	2:18	—	6:2	0:15	1:17	5:0	36:71	40	92.9	3.5	8	820
420	0:10	0:2	0:0	0:10	15:1	1:10	2:6	—	13:1	24:0	7:0	62:40	40	92.2	7.7	6	1,150
668	0:11	0:9	1:5	0:14	1:17	1:23	15:0	1:13	—	14:0	18:0	51:92	30	91.0	4.3	4	901
758	0:9	0:9	0:3	0:6	0:12	0:9	17:1	0:24	0:14	—	10:0	27:87	20	91.6	1.4	3	1,104
347	0:6	0:7	0:2	0:4	0:9	0:6	0:5	0:7	0:18	0:10	—	0:74	0	88.4	21.2	7	952

1951

	348	176	173	332	235	223	420	668	758	347	x871							
348	—	15:0	23:0	35:0	13:0	26:0	23:0	26:0	21:0	17:0	8:0		207:0	100	96.6	0	8	1,504
176	0:15	—	33:0	32:1	6:4	2:31	1:15	34:0	28:1	19:1	8:0		163:68	70	99.0	0	10	1,090
173	0:23	0:33	—	32:4	1:6	2:29	20:1	43:0	14:0	13:0	8:0		133:96	60	99.0	0	10	1,304
332	0:35	1:32	4:32	—	0:5	20:1	13:0	45:0	18:0	21:1	17:0		139:106	60	95.2	0	8	1,300
235	0:13	4:6	6:1	5:0	—	7:0	1:1	7:0	1:0	1:3	8:0		40:24	60	97.1	0	9	1,025
223	0:26	31:2	29:2	1:20	0:7	—	21:4	0:81	2:31	10:2	16:0		110:175	50	97.5	0	9	925
420	0:23	15:1	1:20	0:13	1:1	4:21	—	32:1	33:1	19:0	11:0		116:81	50	94.1	0	7	1,147
668	0:26	0:34	0:43	0:45	0:7	81:0	1:32	—	23:3	32:0	25:0		162:190	40	94.6	0	5	995
758	0:21	1:28	0:14	0:18	0:1	31:2	1:33	3:23	—	33:1	42:0		111:141	30	97.5	0	4	1,220
347	0:17	1:19	0:13	1:21	3:1	2:10	0:19	0:32	1:33	—	23:0		31:165	20	97.1	6.1	8	1,025
x871	0:8	0:8	0:8	0:17	0:8	0:16	0:11	0:25	0:42	0:23	—		0:166	0	86.3	46.6	3	925

1952

	348	332	420	758	347	668	223	530	457	821	942	x871						
348	—	9:0	13:0	8:0	5:0	6:0	11:0	5:0	1:0	9:0	5:0	6:0	78:0	100	97.9	0	9	1,480
332	0:9	—	10:0	8:1	2:0	4:1	21:1	7:0	5:0	10:0	3:0	2:0	72:12	91	97.1	0	9	1,280
420	0:13	0:10	—	8:4	3:2	8:0	2:12	17:0	6:0	27:0	3:0	13:0	87:41	73	96.3	0	8	1,124
758	0:8	1:8	4:8	—	14:0	4:4	11:0	14:0	9:0	17:0	9:0	13:0	96:28	64	99.5	0	5	1,400
347	0:5	0:2	2:3	0:14	—	1:8	2:0	2:1	1:0	6:1	2:0	5:0	21:34	55	97.9	1.1	9	1,153
668	0:6	1:4	0:8	4:4	8:1	—	5:2	3:1	5:1	4:7	9:0	5:0	44:34	55	97.9	0	6	995
223	0:11	1:21	12:2	0:11	0:2	2:5	—	1:8	3:2	20:0	4:0	12:0	55:62	45	96.3	0	10	912
530	0:5	0:7	0:17	0:14	1:2	1:3	8:1	—	3:2	1:4	4:0	12:0	30:55	36	94.2	1.7	7	1,142
457	0:1	0:5	0:6	0:9	0:1	1:5	2:3	2:3	—	3:1	1:0	12:0	21:34	27	65.8	4.8	8	1,175
821	0:9	0:10	0:27	0:17	1:6	7:4	0:20	4:1	1:3	—	0:1	8:0	21:98	27	88.3	0	4	1,080
942	0:5	0:3	0:3	0:9	0:2	0:9	0:4	0:4	0:1	1:0	—	4:0	5:40	18	63.1	2.6	3	943
x871	0:6	0:2	0:13	0:13	0:5	0:5	0:12	0:12	0:12	0:8	0:4	—	0:90	0	94.7	0	4	932

Continued

TABLE 2—*Continued*

Cow No. (arr. by rank)	Recorded butt contests between individual cows Individual contests (won:lost)												Total contests (won:lost)	Percentage of herd dominated	Response to call	Not eating	Age (yrs)	Weight (pounds)
															(per cent)			
1953																		
	332	420	668	758	347	821	457	530	x871	x854	x863	x868						
332	—	14:0	21:0	11:1	14:1	28:0	9:0	10:0	8:0	10:0	5:0	11:0	141:2	100	100.0	0	10	1,245
420	0:14	—	20:1	1:25	1:2	34:10	10:0	8:0	5:0	18:0	12:0	14:0	123:52	73	99.4	0	9	1,155
668	0:21	1:20	—	22:2	17:2	0:24	6:0	5:1	8:0	4:2	9:1	9:0	81:73	73	98.7	0	7	1,006
758	1:11	25:1	2:22	—	20:0	27:0	10:1	9:0	7:2	6:11	6:0	9:0	122:48	73	100.0	0	6	1,414
347	1:14	2:1	2:17	0:20	—	3:10	7:0	2:0	3:0	1:0	2:0	6:0	29:62	64	100.0	0	10	1,100
821	0:28	10:34	24:0	0:27	10:3	—	0:1	11:0	2:0	9:0	4:0	2:2	72:95	55	97.4	0	5	1,282
457	0:9	0:10	0:6	1:10	0:7	1:0	—	0:5	2:0	4:0	7:0	3:1	18:48	45	98.1	0	9	1,232
530	0:10	0:8	1:5	0:9	0:2	0:11	5:0	—	7:0	2:0	3:0	4:0	22:45	45	98.1	0	8	1,270
x871	0:8	0:5	0:8	2:7	0:3	0:2	0:2	0:7	—	1:0	3:0	2:0	8:42	27	100.0	0	5	1,005
x854	0:10	0:18	2:4	11:6	0:1	0:9	0:4	0:2	0:1	—	1:0	0:0	14:55	18	97.4	0	5	1,042
x863	0:5	0:12	1:9	0:6	0:2	0:4	0:7	0:3	0:3	0:1	—	0:0	1:52	0	96.8	0	5	1,090
x868	0:11	0:14	0:9	0:9	0:6	2:2	1:3	0:4	0:2	0:0	0:0	—	3:60	0	96.8	0	5	1,195

AGGRESSIVENESS

The degree to which aggressiveness aids a cow in establishing her rank is difficult to assess because this trait is not easy to measure. During this study it was noted that some cows were more scrappy than others and consequently entered in more contests. Since these contests were randomly recorded, the percentage of contests engaged in by each cow annually might be considered as one measurement of aggressiveness. As measured here aggressiveness as a factor in achieving rank had a significant correlation ($r = 0.82$, $P < 0.01$).

Nonaggressiveness is also difficult to measure, and it was not learned if it had any influence on attainment of rank. Cows that appeared more scrappy than others could be expected (while standing about waiting to be fed) to butt the subdominant cows that came within their reach. However, other more retiring cows would usually stand around the edge of the group. It appeared, at times, that they deliberately avoided butt contests, and in certain instances it was known that they dominated an animal they seemed to avoid. At first these animals were called *shy*, but as a synonym of *timid* this term is not accurate. They were less aggressive. When pushed these cows would fight back. Fewer butt contests were recorded for these cows than for others.

In this study, No. 235 and all the Angus-Herford crossbreds exhibited nonaggressiveness. Even so, No. 235 dominated 7 out of a possible 10 cows in 1950. Since all the crossbreds had this trait, the question comes to mind as to whether nonaggressiveness was hereditary and varied among lines within a breed or among breeds. All were sired by the same Angus bull. As to disposition in handling, the crossbreds were noticeably more nervous than the Herefords.

AGILITY

This is another trait that undoubtedly has influence on attainment of rank but is difficult to assess. However, it has been noticed that agility varies among animals. Most cows in this study were in advanced stages of pregnancy when data collection began each year, and parturition occurred while the data were collected. Thus, late stages of pregnancy might influence agility to varying extents. Another factor affecting agility is soreness of the feet.

Four cows were observed to have greater agility than the others. Two of them, 176 and 420, were in the herd at the start of observation in 1949. At that time 420 was next to bottom in rank, but she and 176 had some furious battles. In more than one instance 420 chased 176 completely out of sight of the feeding area. In a short while 176 would return to be fed, but not 420. While 420 was clearly dominant over 176, the latter would usually not yield without a contest.

No. 668 was a 4-year-old replacement in 1950, and one of the most agile cows in the herd during the study. She was the cow, mentioned before, with a 6-inch horn stub, resulting from improper dehorning, which she used to great advantage until its removal in 1952. It was thought that the horn was partly responsible for her aggressiveness, but its removal did not appear to affect this trait. In 1952 it appeared that No. 758, with her much greater weight, would succeed in dominating No. 668. However, greater agility, for one factor, won out: without a question, in 1953, No. 668 was still dominant over 758. No. 758 was low in agility.

No. x854 was a 5-year-old replacement in 1953 that also had considerable agility. She was especially interesting, because she was one of the cows considered nonaggressive. Although new to the herd, this cow did not yield to No. 758, and some intense battles resulted. At the close of the study No. x854 was dominant over 758.

Although agility was not measured, it appeared of definite value to some animals in aiding them to dominate older and heavier cows that were less agile.

TIMIDITY

Occasionally cows were encountered that were noticeably afraid of others, even though they themselves had the advan-

tage of age and weight. This characteristic of timidity is variable and, as used here, is considered different from the fear shown by some youthful cows, such as 3-year-olds in a mixed-age breeding herd that are at the bottom in social rank. The younger animals may exhibit considerable fear of older animals, but not necessarily so of other cows of their same age class, even though dominated by them.

In one of the mixed-age breeding herds, in 1948, a 4-year-old and a 7-year-old cow were so afraid of the other cows in the herd that they would not come near the feeding area. After the feed had been placed in the troughs and the cows were busy eating, the older cow could be forced up to the troughs, but she would run at the first threat. Other cows seemed to go out of their way to pick on these cows. After about two and one-half months it still appeared that hunger (they had lost considerable weight) was not going to force these animals to overcome their timidity and go to the troughs and eat. They were moved in with a group of 3-year-old heifers. At first they exhibited great fear of the heifers and would not come near their feeding area. However, after several days they gained some confidence and started to fight the heifers and move to the feeding area and eat.

In our 1949–1953 study, No. 347 was the only cow that showed timidity, even though individual younger cows were afraid of older animals in the herd. No. 347 exhibited timidity in 1949 and 1950, but in 1951 she managed to dominate the new 3-year-old replacement (No. x871) and also No. 235 that held a mid-group rank. Overcoming her timidity, No. 347 moved in and ate her supplements; this resulted in a marked increase in body weight and condition. She also showed a better response to call. However, when she moved up to a mid-group rank, she continued to be nonaggressive.

RESPONSE FOR SUPPLEMENTS

The herd used in this study did not contain enough cows to furnish the needed data on the subdominant animals for analytical purposes. Furthermore, since an effort was made to get all cows to the trough, we did not have a free expression of the effects of dominance.

Timid cow No. 347 held the lowest herd rank in 1949 and 1950; in 1951 and 1952 it was No. x871; and in 1953 Nos. x863 and x868 were tied for bottom. The 3-year-olds, as an age class, showed a poorer response to call than older cows. Our study used 3-year-old replacements in 1950, 1951 and 1952. Only one of these cows (x871) was of lowest rank; two were of next lowest rank. The data show that two (x871 and 942) were markedly influenced in their response to call, whereas the third (758) was not markedly different from the more dominant cows in the herd. This third animal was exceptionally large for her age, and weighed 1,104 pounds her first year in the herd. Thus, it is likely that her large weight advantage offset youthfulness.

No. 420 in 1949 and No. 457 in 1952 showed poor response to call (table 2). No. 420's behavior was similar to that of a 3-year-old at the bottom in rank. No. 457 had just been placed in the herd and was 8 years of age. Most of her previous adult life had been spent in an established routine with other cows in other pastures. After transfer to the new herd she spent a good portion of the first few weeks near the east pasture fence trying to get back to her previous pasture and associates. This behavior had been experienced previously, but No. 457 was slower than usual in readjusting. No. 530, the 7-year-old cow also placed in the herd for the first time, had been shifted about previously, and had not been in the same pasture routine for several consecutive years. This was also true of the crossbred replacements in 1953.

SPACE ALLOTMENT AT FEED TROUGHS

Variations in space allotments at the feed troughs did not affect response to call. Amount of supplements eaten per head is also important because some cows are crowded away before the supplements have all been eaten. This effect of crowding was not measured.

In 1949, one trough allotting 3 feet of trough space per cow was used. The following year another trough was added which about doubled the trough space. Observations in this study have shown conditions to be best when the cows must stand close together about the troughs. Presumably the cow can see only what is before her, the cows on either side, and those across the trough from her. Thus, with only 3 feet of trough space per cow, there was less fighting and changing positions while feed was still available. Cows standing close alongside of each other cannot very well fight without backing completely away from the trough. Thus, they are less likely to force their neighbor away. When cows have lots of space they have room to fight and chase subdominants away. In such situations dominant cows have been observed to chase all cows away from their side of the trough.

UTILIZATION OF SELF-FEEDER

An important objective in using a self-feeder on the range to feed a mixed-age breeding herd, is to insure each cow an equal opportunity to get her share of the supplement. We wanted to find out if the cows of lower social rank (usually younger) in a mixed-age herd were getting their share of the feed. Data were not collected throughout the supplemental period, but only in August and September; they therefore should indicate what results can be expected during late summer when dry forage is abundant.

During the August (1955) observation period, the self-feeder contained a mixture of 35 per cent hay salt and 65 per cent cottonseed meal. Average daily supplement consumption per cow was 3.20 pounds—1.12 pounds salt and 2.08 pounds cottonseed meal. At that time a hot spell was in progress, with maximum air temperatures varying from 103° to 107°F. During the September (1956) observation period, the self-feeder contained a mixture of 40 per cent salt and 60 per cent cottonseed meal. Average daily supplement consumption per cow was 2.13 pounds—0.85 pound salt and 1.28 pounds cottonseed meal. Maximum air temperatures were about average, varying from 90° to 95°F.

The consumption of the salt and cottonseed meal supplement was measured by the amount of time each cow spent daily at the feeder taking feed. The rate of feed consumption per minute, and possible variations among cows of different ages and sizes, were not known. In September when the supplement was mixed with 40 per cent salt, each cow's daily consumption was only about 67 per cent, and the time spent eating about 73 per cent, of that in August when the supplement was mixed with 35 per cent salt. Thus, the amount of salt in the salt/supplement mixture may have some bearing on rate of consumption. The salt content of the mixture, and the fineness and dryness of the cottonseed meal, prevent the cattle from bolting the feed and thus retard consumption.

The behavior of cows eating the salt and meal mixture was somewhat similar to that of cows taking coarse ground salt from a lick. They would lick up the feed awhile and then work their tongues about their mouths a bit, to consolidate feed taken, and then lick the ends of their noses a few times, during which the end of the tongue would successively be extended up into the opening of each nostril. Variations in rate of licking up feed were suspected, for example between cows that had the entire side of the feeder to themselves and those that had to compete for feeder space. But such variations were not detected. A few cows were observed taking mouthfuls of feed, but they dropped a considerable amount of their feed and appeared to have difficulty swallowing what they retained in their mouths.

SALT AS A REGULATOR OF SUPPLEMENT INTAKE

Previous experience using salt to regulate daily intake of range supplements by experimental groups has shown considerable variability in consumption rates among pastures, different seasons of the year, and different age groups of cattle. Attempts to use salt regulation for equal daily rates of supplementation in different groups of cattle of the same age and class, but in separate pastures, were not too successful (Wagnon, 1960; Wagnon and Goss, 1961). The effect of age differences on salt tolerance is shown in data from three different age groups of cattle presented in figure 5. These data show, for an approximate 150-day period, an average daily salt consumption per head of 0.39 pound (0.23 to 0.75 pound) for 8-month-old heifers, 0.65 pound (0.29 to 1.20 pounds) for 2-year-old heifers and 0.89 pound (0.28 to 1.74 pounds) for a herd of mixed-age cows varying in age from 3 to 10 years. These data show marked variation in salt consumption among the three different age classes of

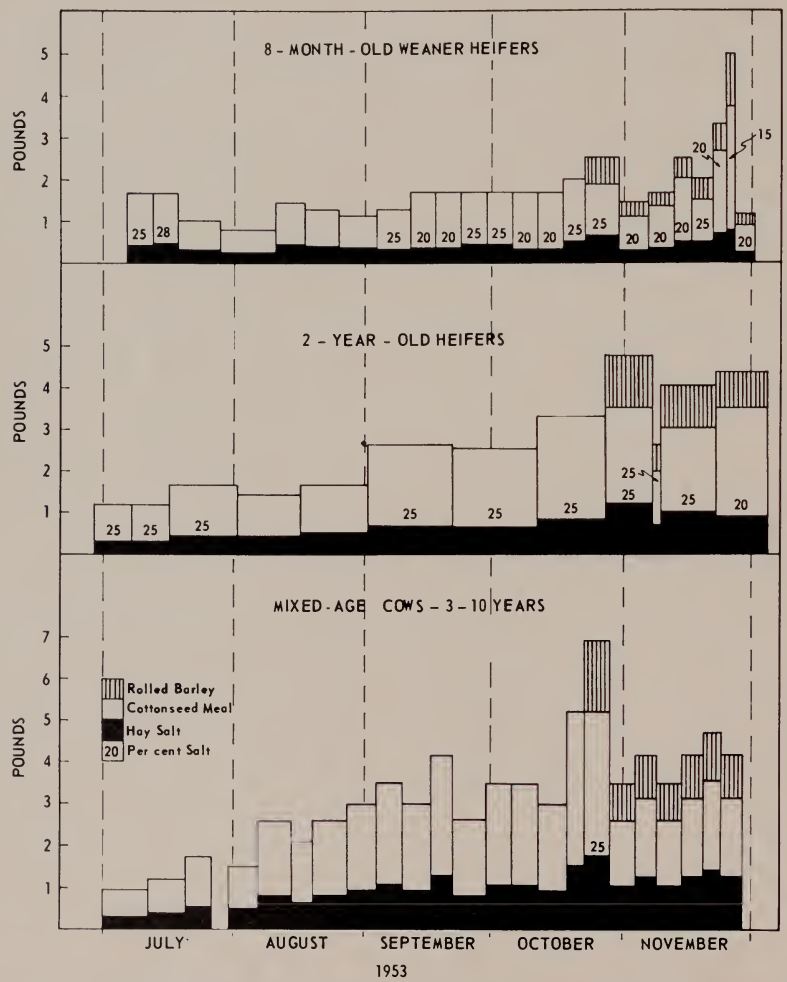

Fig. 5. Self-feeding supplement records for three different classes of range cattle. Results illustrate almost continuous variation in daily consumption. Salt content of each batch of feed is 30 per cent unless otherwise indicated. Rainfall was 0.25 inch October 19; 0.11 inch October 23; 0.08 inch November 11; 2.09 inches November 14, and 0.32 inch November 20.

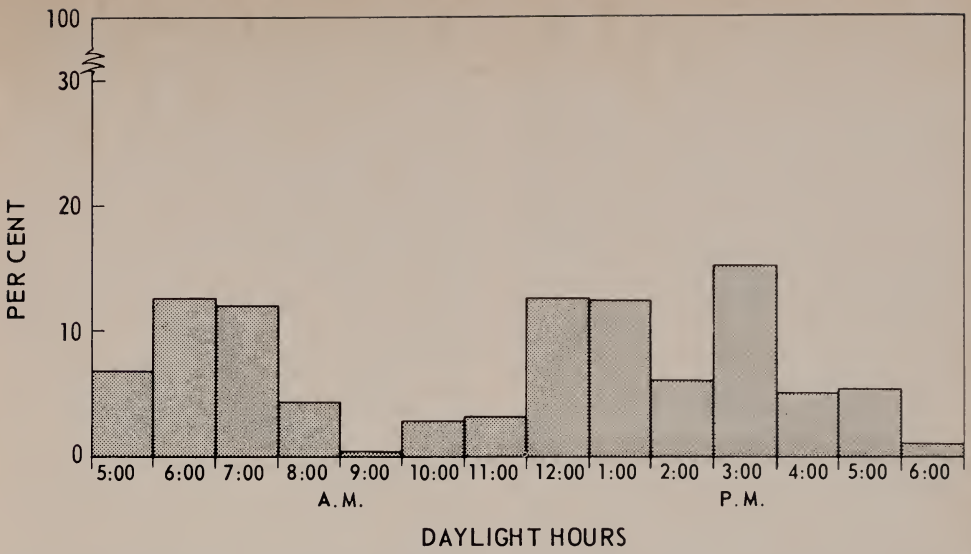

Fig. 6. Initial movement of cows to water-feeder area during each of the daylight hours. Cows did not visit area during the night.

cattle. Thus, there is concern as to what variations may exist among cows of different ages in a mixed-age breeding group, especially those that have not reached maturity.

VARIATIONS IN SOCIAL DOMINANCE

During the period of study it was not possible to collect sufficient data to definitely establish the social rank of each cow in the herd. Thus, it was not possible to check usage of the self-feeder by the actual variations in dominance. However, it was ascertained that the expected relationship between age and social dominance (see above) did exist, and that the younger 4-year-olds and 5-year-olds were at the bottom of the herd in social rank. Thus, we shall consider results by age groups.

MOVEMENT TO FEEDER

The movement of cows to the water-feeder area occurred throughout the daylight hours and was similar to the previously observed movement of cattle during August and September (Wagnon, 1963). The summation of data presented in figure 6 shows that 35.7 per cent of the cows had come in by 9:00 A.M. This movement occurred during and immediately following the morning grazing period. Then followed a marked decrease in cows coming in until midday. The afternoon movements of cattle to the area showed two peaks. The first started about noon and occurred during a period when cows usually did some grazing during other seasons of the year. Previous study (Wagnon, 1963) showed that this class of dry cows, receiving supplements in August and September, did not do much grazing during the day between their early morning and late afternoon major grazing periods. The second peak occurred between 3:00 and 4:00 P.M.—a period in which many range cattle went to water before starting their late afternoon grazing period.

The above behavior in our woodland-grass study area (Hutchison and Kotok, 1942) was different from that observed on the treeless plains or grain stubble areas below in the San Joaquin Valley. In these latter areas practically all the cattle in a field would move to water at the close of their morning grazing period before air temperatures got high, and spend the remainder of the morning concentrated in the vicinity of water. The rate of movement of cattle from remote areas of the pasture to the water-feeder

area is important because it has a bearing on how high the concentration of cattle about these facilities will be.

In August the earliest visits to the water-feeder area occurred from 5:25 A.M. to 5:53 A.M. (average 5.37 A.M.); in September from 6:39 A.M. to 6:58 A.M. (average 6:48 A.M.). The slightly longer hours of daylight in August, as compared with September, may have influenced the earlier movement of cows to the feeder, but weather is also likely to have its effects. The hot spell during August ended at the close of the observation period, and the following morning the first cow did not reach the feeder until 6:28 A.M. The time the last cow left the feeder in the evening varied from 5:52 P.M. to 6:29 P.M. (average 6:14 P.M), in August, and from 6:28 P.M. to 6:52 P.M. (average 6:30 P.M.) in September.

There were some minor exceptions to the above time of movements in September. One evening a few cows, of low social rank, moved only about a quarter of a mile away from the feeder during their evening grazing period. This is uncommon because the forage in the vicinity of water is usually eaten down more quickly than that in the more remote areas soon after a pasture has been stocked. Cattle visiting water early in the day tend to bed awhile in the vicinity during which time they may do some grazing. Also, many will tend to graze as they move away from water. As a consequence the cattle tend to move some distance from water during their late afternoon and night grazing periods. At 5:45 A.M. the following day, when the feeder was first visited, tracks showed that 2 cows had very recently visited water, then the feeder, and then returned to graze. There were 4 cows grazing about 200 yards from the feeder, and subsequent data indicated that two of these were the early morning visitors. One was a 4-year-old and the other a

TABLE 3

AVERAGE NUMBER OF MINUTES COWS USED SELF-FEEDER DAILY

Hour	No cows at feeder	Cows at feeder	Number cows eating at the same time							Total of all cows using feeder
			0‡	1	2	3	4	5	6	
	minutes									
5:00 A.M.	47.7*	12.3	0.67	0.83	6.33	2.83	1.67	0	0	28.7
6:00 A.M.	23.8	36.2	2.33	10.33	10.00	9.67	3.67	0.17	0	74.8
7:00 A.M.	10.8	49.2	5.50	13.00	20.00	7.33	3.17	0.17	0	88.5
8:00 A.M.	34.0	26.0	1.83	13.33	7.67	2.00	1.00	0.17	0	39.5
9:00 A.M.	45.5	14.5	0.67	11.67	2.17	0	0	0	0	16.0
10:00 A.M.	44.7	15.3	0	10.33	1.83	1.83	1.33	0	0	24.8
11:00 A.M.	46.5	13.5	0.67	7.17	4.17	0.67	0.83	0	0	20.8
Forenoon average										
Per hour	36.1	23.9	1.67	9.52	7.45	3.48	1.67	0.07	0	41.9
Per cent	60.2	39.8	7.0	39.9	31.2	14.6	7.00	0.3	0	100.0
12:00 P.M.	22.7	37.3	1.17	7.50	13.33	11.50	3.83	0	0	84.0
1:00 P.M.	8.7	51.3	2.17	6.67	21.00	12.50	8.17	0.50	0.33	123.0
2:00 P.M.	15.2	44.8	2.50	17.33	14.50	8.50	2.00	0	0	79.8
3:00 P.M.	6.5	53.5	3.33	13.00	17.33	11.83	8.00	0	0	115.2
4:00 P.M.	11.0	49.0	2.17	13.67	17.00	10.33	5.50	0.33	0	102.0
5:00 P.M.	4.3	55.7	4.67	17.67	17.50	9.00	6.33	0.50	0	107.5
6:00 P.M.	36.2†	23.8	2.67	9.67	5.83	3.83	1.83	0	0	40.2
Afternoon average										
Per hour	14.9	45.1	2.67	12.21	15.21	9.64	5.10	0.19	0.05	93.2
Per cent	24.9	75.1	5.9	27.1	33.8	21.4	11.3	0.4	0.1	100.0

* Amount of hour before first cow visited feeder.
† Remainder of hour after last cow left feeder.
‡ Cows at feeder but not eating due to fighting or idling; higher rank cows keeping those of lower rank away.

5-year-old. Butting-order data showed the former to be the lowest ranking cow in the herd, and the latter did not rank much higher.

The following day the 5-year-old cow did not visit the feeder until late in the day, and cows of higher rank kept her from spending much time at the feeder. Finally, after a fruitless wait of 68 minutes she moved under a nearby tree and bedded down. When the day's observations ended at 7:00 P.M. and it was rapidly getting dark, no other cows were in sight of the feeder, and this cow was still lying down and ruminating. Early the next morning the facilities were again checked and the evidence indicated that the previous evening this cow had finally visited the feeder, then water, and then had gone off in the direction taken by her associates. This was the only evidence that cows of low social rank visited the feeder at a time of day different from that of cows of higher social rank.

DAILY USE OF FEEDER

Daily attendance at the feeder was high, averaging 98.2 per cent. The cows missing an occasional day were 7-, 8-, and 10-year-olds of mid-social rank or higher in the herd. As the cows came to the feeder, some would move directly up to eat, others appeared to hesitate a moment to "size up" the situation. If the feeder was already occupied by higher ranking cows that would not permit the newcomer to eat, she would wait for an opportunity.

Cows visiting the feeder before mid-afternoon and satisfying their needs for the time, would usually move to a nearby bed, and then visit the feeder at other times during the day. Some that came to the area early in the morning might also engage in limited grazing in the vicinity. Cows of lower social rank that were chased away, or kept from eating, by cows of higher rank, also frequently moved to a nearby tree to wait for a more favorable time to visit the feeder. Those that did not make their initial visit to the feeder until late afternoon usually did not bed in the area, but moved off to graze after satisfying their needs.

Not much information exists on self-feeder space requirements of cattle being supplemented with salt-cottonseed meal mixtures on the range. Albaugh *et al.* (1958) state that about 6 inches of space should be allowed per animal. Experience from feeding cattle on the range has shown that age and sex are important factors in space requirements. Variations in size are important, and those in aggressive behavior even more so. Where heifer and steer weaners or yearlings will crowd around a self-feeder as tightly as they can pack, one aggressive cow may keep all others of lower social rank from eating alongside her. Problems caused by aggression were manifest at a much younger age in bulls than heifers. The self-feeder used in this study was 8 feet long and had room for 4 cows per side to eat at the same time (fig. 7). For the herd this was an allowance of about 4 inches of feeder space per cow.

The average day of self-feeder utilization was 12.6 hours—about evenly divided before and after midday. Data presented in figure 8 show that in this study, on the average, high concentrations of cows at the feeder was not a serious problem. For 36.2 per cent of the day no cows were at the feeder and for 14.6 per cent of the day only one cow was present. During these times cows that had previously visited the feeder were bedded in the vicinity.

These data also show that the heaviest concentrations of cows at the feeder occurred after midday. Cows that visited the feeder before noon usually did so again in the afternoon and consequently competed with the greater percentage of cows that did not make their initial visit to the feeder until after midday. Figure 9 shows the heavy sustained use through the afternoon hours. It is apparent that cows of low social rank have a better opportunity to utilize the feeder before noon than afterwards. If they wait until late afternoon to make their initial visit to the feeder, they must spend considerable time waiting for an opportunity to eat and then may leave the area before satisfying their needs.

The feeder in this study could accommodate 8 cows feeding at a time, but the

Fig. 7. Eight-foot self-feeder allotting about 4 inches of feeder space per cow in the herd. As can be seen, three cows could comfortably eat on each side, and if they stood close together, four could eat on each side at the same time. Actually, this seldom occurred.

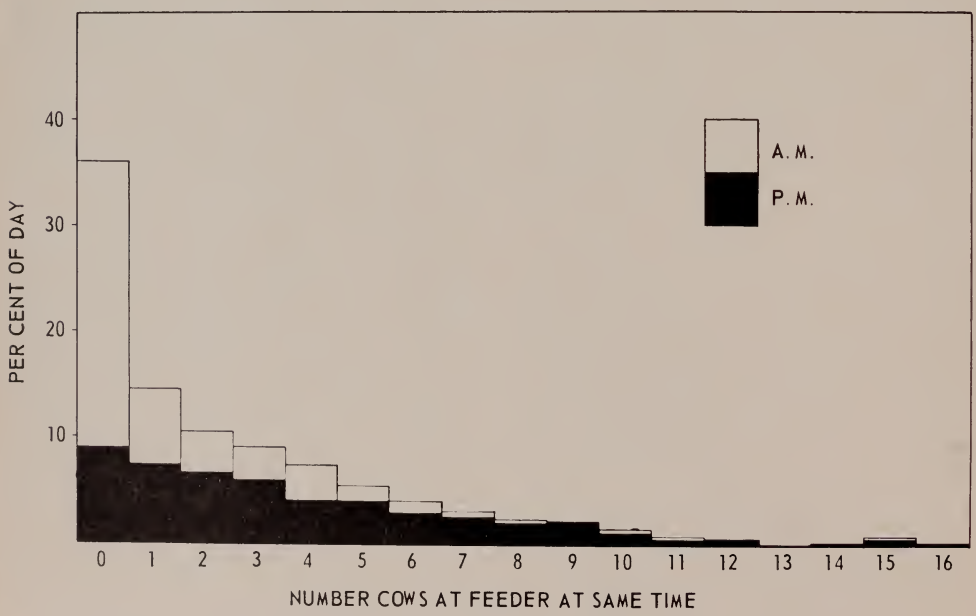

Fig. 8. Concentration of cows at self-feeder for the average day of utilization.

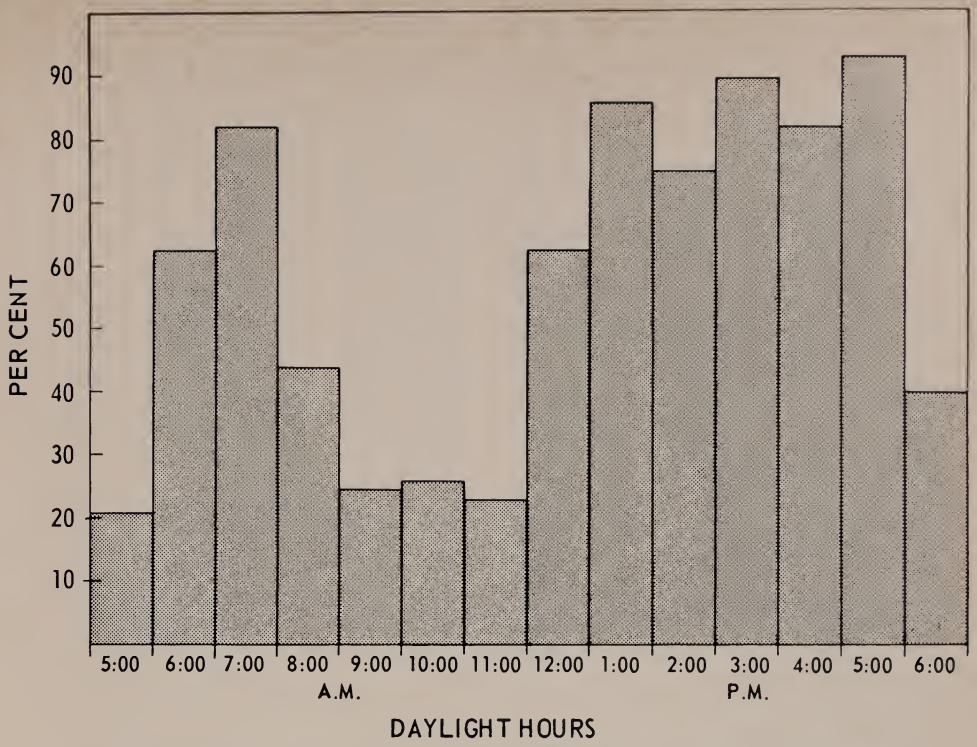

Fig. 9. Average per cent of each daylight hour that cows were eating at the self-feeder.

data presented in table 3 show that this never happened, and that only seldom did more than 4 cows use the feeder at one time. For the average day, greatest use of the feeder was made by 2 cows (32.9 per cent of the time) and by 1 cow (31.5 per cent of the time)—a difference which was not significant. However, in the forenoon, when competition was less, greatest use was made by 1 cow (39.9 per cent of the time). In the afternoon when competition was highest the greatest use of the feeder was made by 2 cows, eating 33.8 per cent of the time. Highest usage by 3 and 4 cows eating at a time also occurred in the afternoon—21.4 and 11.3 per cent, respectively.

It has been shown that during about half the average day there was no competition for use of the feeder, because none or only one cow was present. The remainder of the day, from 2 to 16 cows were at the feeder at a time, and it was during this period that the influence of variation in rank would be manifest. Table 4 summarizes data showing the concentration of cows at the feeder while it was being utilized by various numbers of cows. These data show that for 38.3 per cent of the time, when no cows were eating, 1 cow was at the feeder, and she was standing idle. Two cows were present 15.9 per cent of the time, and for three-fourths of this time they were standing idle, and for one-fourth a dominant cow was chasing a subdominant one. For the remaining 45.8 per cent of the time, when 3 or more cows were present, they were standing idle only one-sixth of the time and milling about the feeder the rest of the time. Thus, the effects of dominance may become a factor when 2 or more cows are present. As the number of cows utilizing the feeder at a time increased (from 1 to 5) so did the competition from increasing concentrations of cows present. Thus, when only 1 cow was utilizing the feeder no other cows were present for 64.8 per cent of the time, whereas this was true for only 10.2 per cent of the

TABLE 4

RATIO OF NUMBER OF COWS EATING AT SELF-FEEDER TO NUMBER NOT EATING

Number of cows eating same time	Number of cows at feeder waiting to eat, standing idle or fighting																Total minutes
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
	minutes (per cent of total time given in parentheses)																
0	0 (0)	11.6 (38.3)	4.8 (15.9)	3.7 (12.0)	4.0 (13.8)	1.7 (5.5)	1.3 (4.4)	0.8 (2.7)	1.0 (3.3)	0 (0)	0.7 (2.2)	0.5 (1.6)	0.2 (0.5)	0 (0)	0.2 (0.5)	0 (0)	30.5
1	98.7 (64.8)	18.0 (11.8)	12.3 (8.1)	6.2 (4.1)	4.7 (3.1)	2.7 (1.8)	2.5 (1.6)	1.7 (1.1)	2.0 (1.3)	0.8 (0.6)	0.5 (0.3)	0 (0)	0.2 (0.1)	0.2 (0.1)	1.2 (0.8)	0.7 (0.4)	152.2
2	55.8 (35.2)	33.3 (21.0)	22.0 (13.9)	13.0 (8.2)	8.0 (5.1)	7.3 (4.6)	3.3 (2.1)	4.0 (2.5)	3.2 (2.0)	2.3 (1.5)	1.2 (0.7)	1.0 (0.6)	1.3 (0.8)	2.0 (1.3)	0.8 (0.5)	0 (0)	158.7
3	20.7 (22.5)	18.8 (20.5)	15.3 (16.7)	8.3 (9.1)	8.5 (9.3)	5.3 (5.8)	4.7 (5.1)	3.0 (3.3)	1.5 (1.6)	3.3 (3.6)	0 (0)	0.7 (0.7)	1.7 (1.8)	0 (0)	0 (0)	0 (0)	91.8
4	4.8 (10.2)	6.8 (14.4)	9.8 (20.8)	5.0 (10.6)	6.5 (13.7)	5.5 (11.6)	3.7 (7.7)	1.2 (2.5)	0.5 (1.1)	0.7 (1.4)	0.3 (0.7)	2.0 (4.2)	0.5 (1.1)	0 (0)	0 (0)	0 (0)	47.3
5	0.2 (9.1)	0.3 (18.2)	0 (0)	0 (0)	0.5 (27.3)	0.2 (9.1)	0.2 (9.1)	0 (0)	0 (0)	0 (0)	0 (0)	0.5 (27.3)	0 (0)	0 (0)	0 (0)	0 (0)	1.8
6	0 (0)	0 (0)	0 (0)	0.3 (100.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.3
Total	180.2 (37.3)	88.8 (18.4)	64.2 (13.3)	36.5 (7.6)	32.2 (6.7)	22.7 (4.7)	15.7 (3.3)	10.7 (2.2)	8.2 (1.7)	7.1 (1.5)	2.7 (0.6)	4.7 (1.0)	3.9 (0.8)	2.2 (0.4)	2.2 (0.4)	0.7 (0.1)	482.7

time when 4 cows were eating at a time. When both sides of the feeder were being utilized and other cows were standing by, these latter cows were mostly waiting for an opportunity to eat when a dominant cow would allow them. Often when 2 cows were eating side by side and the higher ranking cow stopped eating, the cow of lower rank would do likewise until she knew that she was allowed to resume eating. Idling boss cows, at times for short periods, would deliberately keep a cow of lower rank from eating and in some instances would chase them from the feeder area. This also was observed, once or twice, among companions of small groups that traveled and grazed together.

FEEDER UTILIZATION BY AGE GROUP

We do not have enough data to show the initial movement of cows to the feeder hourly by age group. However, data in table 5 show that 42.2 per cent of the cows initially moved to the feeder in the forenoon and 57.8 per cent in the afternoon. The data also show that 68.6 per cent of the 4-year-olds went to the feeder initially in the forenoon, whereas all other groups were below 50 per cent. If the lowest ranking 4- and 5-year-olds are combined, we find that 58.6 per cent went to the feeder initially in the morning as compared with 33.1 per cent for the 6- through 10-year-olds combined. Thus, a greater number of the low-ranking cows tended to visit the feeder in the morning, when there was less competition for its use.

Table 6 shows the average amount of time each age group spent at the feeder in the forenoon, afternoon, and for the entire day. The data are grouped to compare the lower social ranking 4- and 5-year-olds with the combined older animals.

These data show that the cows visiting the feeder in the forenoon spent less time at the various activities of eating, waiting to eat, and idling than they did in the afternoon. Apparently the cows that visited the feeder in the forenoon intended to make later visits in the afternoon, as most of them did. In terms of day averages, the combined 4- and 5-year-olds spent 17.1 minutes eating, 31.0 minutes waiting for an opportunity to eat, and only 2.8 minutes idling; the combined older cows spent 22.3, 11.5, and 5.4 minutes, respectively, on these same activities. The combined younger age groups showed an average gain of only 36.8 pounds for the first 83 days of supplementation on dry forage, as compared with 60.1 pounds for the combined older cows. Although the data fail to show significance, possibly from inadequate numbers, the evidence suggests that these younger cows were not allowed to eat fully from the feeder. Also, it is not known if they have the same tolerance for salt

Table 5

TIME OF INITIAL MOVEMENT OF DIFFERENT AGE GROUPS TO THE SELF-FEEDER

Age groups	Total animal days	Initial movement to feeder			
		In the forenoon		In the afternoon	
years		*days*	*per cent of total days*	*days*	*per cent of total days*
4	51	35	68.6	16	31.4
5	48	23	47.9	25	52.1
6	36	9	25.0	27	75.0
7	30	13	43.3	17	56.7
8	35	16	45.7	19	54.3
9	42	10	23.8	32	76.2
10	35	11	31.4	24	68.6
Total or average	277	117	42.2	160	57.8

TABLE 6

AVERAGE TIME EACH AGE GROUP SPENT AT FEEDER DAILY, FORENOON AND AFTERNOON, EATING, WAITING TO EAT, AND STANDING IDLE, WITH AVERAGE WEIGHT GAIN FOR 83-DAY PERIOD BEGINNING JULY 6

Age group	Cow days	Forenoon				Afternoon				Day				Average wt. gain
		Total	Idle	Waiting	Eating	Total	Idle	Waiting	Eating	Total	Idle	Waiting	Eating	
years		*minutes*												*pounds*
4.....	51	17.1	1.5	7.4	8.2	31.2	1.1	20.1	10.0	48.3	2.6	27.5	18.2	46.5
5.....	48	13.8	1.1	6.9	5.8	39.7	1.9	27.7	10.1	53.5	3.0	34.6	15.9	26.5
6.....	36	8.7	1.6	2.7	4.4	29.8	2.3	12.5	15.0	38.5	3.9	15.2	19.4	54.5
7.....	30	13.4	0.4	3.8	9.2	31.6	4.7	10.4	16.5	45.0	5.1	14.2	25.7	59.6
8.....	35	13.2	1.0	4.8	7.4	29.8	5.0	6.7	18.1	43.0	6.0	11.5	25.5	78.3
9.....	42	6.5	0.9	1.5	4.1	28.1	4.8	8.5	14.8	34.6	5.7	10.0	18.9	60.3
10.....	35	8.7	1.2	2.0	5.5	28.0	5.1	5.1	17.8	36.7	6.3	7.1	23.3	47.5
4 and 5	99	15.5	1.3	7.2	7.0	35.4	1.5	23.8	10.1	50.9	2.8	31.0	17.1	36.8
6 to 10	178	9.8	1.0	2.9	5.9	29.4	4.4	8.6	16.4	39.2	5.4	11.5	22.3	60.1
Total herd	277	11.9	1.1	4.4	6.4	31.5	3.4	14.0	14.1	43.4	4.5	18.4	20.5	51.9

as the older cows. If not, this would tend to reduce further their daily consumption of salt-cottonseed meal.

WATERING

Because of the possibility of salt poisoning, adequate supplies of water should be readily available when salt-regulated supplement mixtures are fed to cattle. It has been shown that practically all of the ingested salt is absorbed into the blood stream, and that water is needed to produce urine to flush the excess salt from the animal's body (Cardon *et al.*, 1951). About 5 gallons of urine must be produced to remove 1 pound of salt, thus a cow's daily water requirements may be quite high. This is especially so if the forage is completely dry and maximum air temperatures are high. As much as 20 gallons per head daily may be required under some situations (Riggs *et al.*, 1953).

Our experience with self-feeding salt-cottonseed meal mixtures to range cattle showed heavy traffic between the water supply and the feeder. Under our conditions the cattle readily moved from water or place of supplementation to the remote areas of the pasture to graze. In supplementing (by hand) pregnant cows on the range, it was more difficult to get the cows to come to the feeding area if water was distant than if it was near. Some cows would visit water first and then apparently did not want to climb the hill to the feeding area because of a heavy fill of water. When the salt-meal feeder was placed in a similarly remote location, even more difficulty was encountered, apparently caused by the even greater fills of water because of the salt intake. This effect of heavy water fill was well illustrated from the data collected during the 24-hour observation of a cow in late gestation that was being supplemented with a salt-cottonseed meal mixture (Wagnon, 1963). Observation began in the late afternoon when the cows were leaving the feeder-water area to start their late-afternoon grazing period. The cow under observation had already traveled about 250 feet from water, and her sides were so distended by water fill (plus ruminal fill and fetus) that she was in obvious discomfort. The cow traveled about 1,400 feet climbing about 75 feet, before she started grazing in earnest. To move the distance took 25 minutes of slow walking interspersed with 29 minutes of standing. This is one of the reasons why we usually placed the self-feeder somewhere within a quarter-mile radius of water, and in this study about 280 feet from water.

In our study we found that 4.0 per cent of the cows watered four times daily, 17.7 per cent three times daily, 57.0 per cent twice daily, 20.6 per cent once daily, and 0.7 per cent were not seen to water. However, it is known that these latter watered outside the observation period. Because of the distance from water and the task of recording data at the feeder, it is possible that some cows watered more frequently than was recorded. Ignoring the two cows of low social rank that were not actually seen drinking, 74.0 per cent of the cows watered before they came to the feeder to eat. Of these, 72.9 per cent took water again just before leaving the area to graze. Of the 26.0 per cent that went to the feeder without drinking, 81.9 per cent drank just before leaving to graze, and all the others watered at different times previously. When reaching the water-feeder area, the 4-year-olds appeared to be the most eager to get to the feeder, and 38.9 per cent of those not watering first were of this youngest age class.

The cows coming to the feeder before watering spent an average 8.4 minutes eating salt-cottonseed meal and had a total average interval of 57.7 minutes before going to water. However, 76.4 per cent left for water 20.1 minutes after their arrival at the feeder. The remaining 23.6 per cent moved from the feeder to a bed and did not reach water until 179.6 minutes after their initial arrival at water.

Since most cows had passed the midpoint in their stage of gestation, most left the area with their sides tightly distended from large draughts of water.

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